

WHAT IS CLAIMED IS:

- 1 1. A streptococcal choline binding protein wherein the protein is expressed by
2 *Streptococcus* and has the following characteristics:
 - 3 a) choline-binding activity; and
 - 4 b) elution from a chromatographic column in the presence of at least
5 about 10% choline;
 - 6 with the proviso that the streptococcal choline binding protein is not PspA or
7 autolysin (LytA).
- 1 2. The streptococcal choline binding protein of claim 1, having one or more of
2 a characteristic selected from the group consisting of:
 - 3 c) inhibiting adherence of the bacteria to host cells;
 - 4 d) being reactive with sera from patients infected or recovering from
5 infection with the bacteria;
 - 6 e) being reactive with rabbit antisera generated against pneumococcal
7 proteins isolated from a choline affinity column by elution in at least about
8 10% choline; and
 - 9 f) being labeled by fluorescein isothiocyanate (FITC) without requiring
10 streptococcal lysis (*i.e.*, in intact bacteria).
- 1 3. The streptococcal choline binding protein of Claim 1 which is isolated from
2 *Streptococcus pneumoniae*.
- 1 4. The streptococcal choline binding protein of claim 3 which has an apparent
2 molecular weight by at least about 10% SDS-PAGE selected from the group
3 consisting of: 112 kDa, 90 kDa, 84 kDa, 70 kDa, and 50 kDa.

- 4 5. The streptococcal choline binding protein of Claim 1 which has a partial
5 amino acid sequence selected from the groups consisting of SEQ ID NOS:1-10,
6 SEQ ID NO:19, SEQ ID NO:21 and SEQ ID NO: 25.
- 1 6. The streptococcal choline binding protein of Claim 1 labeled with a
2 detectable label.
- 1 7. A streptococcal choline binding protein having an amino acid sequence of
2 SEQ ID NO:19.
- 1 8. A streptococcal choline binding protein having an amino acid sequence of
2 SEQ ID NO:25.
- 1 9. A vaccine comprising the streptococcal choline binding protein of claim 1
2 and a pharmaceutically acceptable adjuvant.
- 1 10. The vaccine of claim 9, further comprising an antigen selected from the
2 group consisting of:
3 a) a different streptococcal choline binding protein;
4 b) PspA;
5 c) autolysin (LytA); and
6 d) any combination of one or more of the foregoing.
- 1 11. A pharmaceutical composition comprising a streptococcal choline binding
2 protein of claim 1 and a pharmaceutically acceptable carrier.
- 1 12. The pharmaceutical composition of claim 11, further comprising an active
2 ingredient selected from the group consisting of:
3 a) PspA or autolysin (LytA);

- 4 b) an antibiotic;
- 5 c) an anti-streptococcal choline binding protein vaccine, wherein the
- 6 choline binding protein has the following characteristics:
- 7 i) choline-binding activity; and
- 8 ii) elution from a chromatographic column in the presence of at
- 9 least about 10% choline;
- 10 with the proviso that the streptococcal choline binding protein is not PspA or
- 11 autolysin (LytA);
- 12 d) a steroid; and
- 13 e) an anti-streptococcal vaccine.

- 1 13. A purified antibody to a streptococcal choline binding protein which choline
- 2 binding protein has the following characteristics:
- 3 a) choline-binding activity; and
- 4 b) elution from a chromatographic column in the presence of at least
- 5 about 10% choline;
- 6 with the proviso that the streptococcal choline binding protein is not PspA or
- 7 autolysin (LytA).

- 1 14. A monoclonal antibody to the streptococcal choline binding protein of claim
- 2 1.

- 1 15. An immortal cell line that produces a monoclonal antibody according to
- 2 Claim 14.

- 1 16. The antibody of Claim 14 labeled with a detectable label.

- 1 17. The antibody of Claim 16 wherein the label is selected from the group
2 consisting of an enzyme, a chemical which fluoresces, and a radioactive elements.
- 1 18. A pharmaceutical composition comprising an antibody to a choline binding
2 protein of claim 1 and a pharmaceutically acceptable carrier.
- 1 19. A purified nucleic acid which encodes the streptococcal choline binding
2 protein of claim 1, or a fragment thereof of at least 15 nucleotides.
- 1 20. The nucleic acid of claim 19 which is a DNA molecule having a nucleotide
2 sequence selected from the group consisting of:
3 a) a DNA sequence encoding a polypeptide having sequence as depicted
4 in SEQ ID NOS:1-10, or 19 or 21 or 25;
5 b) a DNA sequence that hybridizes to the DNA sequence of (a) under
6 highly stringent hybridization conditions; and
7 c) a DNA sequence that encodes an amino acid sequence encoded by
8 the foregoing DNA sequences of (A) or (B).
- 9 21. A recombinant DNA molecule of claim 20.
- 1 22. The recombinant DNA molecule of claim 21, which has a nucleotide
2 sequence as depicted in SEQ.ID NO:18 from nucleotide 1 through the stop codon
3 TAA.
- 1 23. The recombinant DNA molecule of claim 21, which has a nucleotide
2 sequence as depicted in the coding region of SEQ ID NO: 24.
- 1 24. The recombinant DNA molecule of claim 22, wherein the DNA molecule is
2 operatively linked to an expression control sequence.

1 25. An oligonucleotide capable of screening for a nucleic acid encoding the
2 streptococcal choline binding protein in alternate species prepared from the nucleic
3 acid of claim 19.

1 26. A unicellular host transformed with a recombinant DNA molecule of claim
2 24.

1 27. A nucleic acid vaccine comprising the recombinant DNA molecule of claim
2 24.

1 28. A method for detecting the presence of a streptococcal choline binding
2 protein of claim 1, wherein the streptococcal choline binding protein is measured
3 by:
4 a) contacting a sample from in which the presence or activity of the
5 streptococcal choline binding protein is suspected with an antibody to the
6 streptococcal choline binding protein under conditions that allow binding of
7 the streptococcal choline binding protein to the binding partner to occur; and
8
9 b) detecting whether binding has occurred between the streptococcal
10 choline binding protein from the sample and the antibody;
11 wherein the detection of binding indicates that presence or activity of the
12 streptococcal choline binding protein in the sample.

1 29. A method for detecting the presence of a bacterium having a gene for a
2 streptococcal choline binding protein of claim 1, comprising:
3 a) contacting a sample in which the presence or activity of the
4 bacterium is suspected with an oligonucleotide which hybridizes to the
5 streptococcal binding protein gene under conditions that allow specific
6 hybridization of the oligonucleotide to the gene to occur; and

7 b) detecting whether hybridization has occurred between the
8 oligonucleotide and the gene;
9 wherein the detection of hybridization indicates that presence or activity of the
10 bacterium in the sample.

1 30. A method for preventing infection with a bacterium that expresses a
2 streptococcal choline binding protein comprising administering an immunogenically
3 effective dose of a vaccine of claim 9 to a subject.

1 31. A method for preventing infection with a bacterium that expresses a
2 streptococcal choline binding protein comprising administering an immunogenically
3 effective dose of a vaccine of claim 27 to a subject.

1 32. A method for treating infection with a bacterium that expresses a
2 streptococcal choline binding protein comprising administering a therapeutically
3 effective dose of a pharmaceutical composition of claim 11 to a subject.

1 33. A method for treating infection with a bacterium that expresses a
2 streptococcal choline binding protein comprising administering a therapeutically
3 effective dose of a pharmaceutical composition of claim 18 to a subject.

1 34. A pharmaceutical composition comprising an inhibitor of streptococcal
2 adhesion to fibronectin selected from the group consisting of a peptide of not more
3 than 15 amino acid residues having the amino acid sequence WQPPRARI (SEQ ID
4 NO:11), an enolase, and an antibody specific for the amino acid sequence
5 WQPPRARI.

1 35. A method for treating infection with a bacterium that expresses a
2 streptococcal choline binding protein comprising administering a therapeutically
3 effective dose of a pharmaceutical composition of claim 34 to a subject.

1 36. A method for treating infection with a bacterium that expresses a
2 streptococcal choline binding protein comprising administering a hindered cationic
3 small molecule that inhibits streptococcal adhesion to fibronectin.

1 37. The method according to claim 36 wherein the hindered cationic small
2 molecule is selected from the group consisting of lysine, choline, and arginine.

1 38. The method according to claim 36 wherein the hindered cationic small
2 molecule inhibits binding of an enolase to fibronectin.

1 39. A method for treating infection with a bacterium that expresses a
2 streptococcal choline binding protein comprising administering pulmonarily an
3 adhesion inhibitory agent selected from the group consisting of a choline binding
4 protein having the following characteristics:
5 a) choline-binding activity; and
6 b) elution from a chromatographic column in the presence of at least
7 about 10% choline;
8 with the proviso that the streptococcal choline binding protein is not PspA or
9 autolysin (LytA), an antibody to a choline binding protein, an enolase, a hindered
10 cationic small molecule, the peptide WQPPRARI (SEQ ID NO:11), and an antibody
11 specific for an epitope having the amino acid sequence WQPPRARI (SEQ ID
12 NO:11).

1 40. The method according to claim 39 wherein the hindered cationic small
2 molecule is selected from the group consisting of lysine, choline, and arginine.